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**GJMBR-C Classification :** *FOR Code:150304 JEL Code: G32*



CEOSCOMMITMENTBIASANDITSFIRMRDLEVELBAYESIANNETWORKMETHODEVIDENCEFORMTUNISIA

*Strictly as per the compliance and regulations of:*



# CEO's Commitment Bias and its Firm R&D Level Bayesian Network Method: Evidence form Tunisia

Hamza Fadhila <sup>α</sup>, Azouzi Mohamed Ali <sup>σ</sup> & Jarboui Anis <sup>ρ</sup>

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**Keywords:** *commitment bias, managerial discretion, innovation, ceo's incentives, optimism, myopia, loss aversion, executive power, overconfidence, bayesian network method.*

**Jel Classification Code:** g14, g31, g32, d80

## 1. INTRODUCTION

The most polemic financial issue that is mainly discussed is the "Managerial discretion", or also "Latitude of action". This issue persists because both executives and shareholders diverge in how much discretionary space managers should have.

Consequently, many of researches are conducted in order to studying the managerial latitude's determinants and its effect on a firm's performance and strategic choices (Hambrick and Abrahamson, 1995).

According to wirtz (2011), Charreaux (2008) and Hambrick and Finkelstein (1987), managerial latitude is determined by three levels: firm's external environment,

organizational features and personal characteristics. Firstly, at the firm's external environment level, factors determining managerial latitude comprise non specific governance mechanisms; secondly, at the organizational structure level, managerial discretion determinants include specific governance mechanisms; and, finally, at the personal level, characteristics that leading to managerial latitude contains: professional aspiration, locus of control, cognitive pattern, power factors (Hambrick and Finkelstein, 1987).

Consequently to this theoretical development, there have been an increasing number of researches on managerial latitude at all three levels. Each of these levels has a great role in increasing or decreasing managerial discretion. While, from the three determinants of managerial latitude; organizational structure level have been most intensively considered (wirtz, 2011; Charreaux, 2008). They are mainly resumed in governance mechanisms.

Our study contributes to the literature examining the relationship between manager's remuneration (as a latitude determinant) and innovation (as a CEO's behavior). Numerous other study investigate this issue such one advanced by Lerner and Wulf (2007) that empirically examines this relationship.

Thus, it is proved that incenting managers for good performance and protecting them from bad performance wished have an encouraging effect on innovation. Though, when an important part of manager's wealth is linked to the stock price, managers can make significant profit when the market rise but parallel they are uncovered in moment of downswings. Companies can decide to protect managers from reversals in stock price particularly if poor firm performance creates external opportunities more attractive (Oyer 2004; Bizjak, et al., 2008).

This literature approaches direct effect of the incentives system (persuasion) on the CEO's innovation decision (behavior). However, by referring to theories of behavior changing (theory of persuasion, theory of commitment), the existence of a cause-effect relationship between persuasion (using motivation) and behavioral change is profusely challenged.

Accordingly to the theory of commitment (Joule et al., 2007; Girandola, 2005, Girandola et al, 2008), persuasion may conducts, consistently, to an attitude

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changes, rarely, to a behavioral intention, but, not necessarily, to authentic behavior. The authentic behavior can be contracted only when there is a solid link of commitment between individual and this act. Therefore, our interest here is to mediate CEO's cognitive characteristics (attitude) in the relationship between the CEO's incentives (persuasion) and decisional latitude on innovation investment (authentic behavior)

While, in our study we are interested in reviewing the role of CEO's incentives as a determinant of managerial discretion in companies R & D investment through their impact on CEO's attitude (optimism, myopia, loss aversion, executive power and overconfidence). Although this investigated impact of CEO's incentives on the CEO's mental patterns and consequently on their behavior is conditioned by the clause of the existence or not of the CEO's cognitive commitment.

The article is structured as follows: Section 1 presents the related literature and the theories which motivate the empirical work, section 2 discusses the empirical strategies that were adopted and section 3 presents the main results and discussion.

## II. LITERATURE REVIEW

### a) *CEO's Incentives, CEO's Optimism, CEO's Commitment and Innovation Decision*

Numerous researches have been using the agency theory, as well as a number of other psychological/sociological theories, to explicate the relationship between remuneration packages, CEO's behavior and interest alignment.

The principal can discipline the agent if he fails to create output. The menace of turnover can be harmful to innovation because innovative projects are threatened by a high risk of failure.

Given the character of innovation, Holmstrom (1989) and Manso (2007) advance that incentive compensations which persuade this sort of investment should have a high tolerance of failure. If the manager is disciplined for first time failures, he is disheartened from investing effort on tasks that have a larger probability of failing. In the same manner, if the manager is rewarded for first time success he become more optimistic about these activities and their own skills, also, he will be encouraged to develop and employ the same talents rather than investigate new ideas.

In firms that threatened by takeover, using golden parachutes seem to be more pertinent when investigating the role of CEO's incentives in promoting in innovations investments. Additional to the takeover perspective, golden parachutes can also be considered as long-term incentives which create optimistic behavior. For example, Brusa et al., (2007) show that

firms who use golden parachutes perform more than other don't use this sort of incentives either in short or long term. Brusa et al., (2007) demonstrate that golden parachutes are an efficient instrument in reducing agency costs related to under-investment and shirking. As encouraging optimistic attitudes and behaviors by protecting manager from failure and persuading executive to invest in innovation, Francisa et al., (2012) predict a significant relationship between golden parachutes and research and development initiatives.

Authors argue that manager's compensation systems composed by incentives that are more tolerant to failure are more appropriate for innovation. It help to absorb the shock that manager may feel while deciding risky investment and, so, encouraging optimistic behavior.

Contrary, Holmstrom (1989) show that CEO's incentives exhibit high level of optimism and motivate executive to invest in innovation. However, too much manager's incentives could distort managerial right goals and lead to non performance. Author concludes that such underinvestment might be the result of increasing the incentives intensity.

In our study we try to present evidence consistent with this logic through inserting the further logic confirmed by the psychological theory of persuasion and earlier the theory of commitment.

Therefore, number of researchers on the persuasion paradigm (Girandola et al, 2008; Chappé et al, 2007) show that motivation arise the sense of "efficacy" of the polemic task. The motivated individual is affected by a "comparative optimism" than non motivated one (Chappé et al, 2007). Thus face to a certain level of motivation individual doesn't have, habitually, a pessimist attitude.

While the theory of commitment, (Joule et al., 2007; Girandola, 2005, Girandola et al, 2008), demonstrate that motivation might be efficient in changing attitude but cannot modify behavior. Argued, the link between attitude and behavior is activated, only, by means of commitment bias (Deschamps and Joule, 2005). Based on this affirmation, we hypothesize that if the relationship between manager and R&D decision is qualified by a high level of cognitive and psychological commitment, the influence of the nature of CEO's compensation on the CEO's optimism, affect consequently his behavior. In the other hand, with the absence of commitment link between manager and R&D decision, the effect of motivation on CEO's optimism cannot lead to a positive CEO's innovation behavior.

*So, our hypothesis is as follow:*

**H1:** *The presence of based-on performance remuneration increases generally the CEO's optimism attitude.*

**H1':** *With the presence of commitment bias the influence of based-on performance remuneration on CEO's optimism lead to an effective behavior in favor of R&D investment.*

**b) CEO's Incentives, CEO's Myopia, CEO's Commitment Bias and Innovation Decision**

Long-term remuneration packages are more appropriate for innovation. Further, with long-term compensation, Manso (2007) affirm that regardless to the risk of agent opportunism it is perceived less costly for agents to innovate than to avoid. Manso (2007) also shows that in the innovation decision manager can make deviation, moreover he could have more information about the project's rate of success. Thus, optimal incentive compensation for innovation should engage the agent to long-term commitment and protect him from failure. Manso (2007) construct model in which he provides a logical explanation and validation for the existence of commitment, partition packages, bankruptcy codes and excessive remuneration with stock option.

Kole (1997) also argues that long-term compensations incite managers to be engaged with the firm and constraint them from making myopic decisions. Therefore, manager's remuneration could be the major link in the relationship between long-term commitment and innovation. For innovation projects, which need particular expertise and have long growth periods, firms should provide long-term remuneration.

Chi and Johnson (2008) affirm that incentives influence largely firm-value better for unvested options and they rise with the duration of the vesting period. Following Francisa et al., (2012) show a positive relationship between options, unvested and vested options, which correspond to long-term commitment and innovation.

Companies can also apply deferred compensation and stock grants to guarantee long-term manager's commitment. Though, remuneration based on options and deferred compensation does not automatically encourage the manager to long-term invest and innovate.

Manso (2007) argues that the use of stock options offers to managers the needed incentives to decide innovation. Also, stock options cover a lengthy expiration period, which guarantees long-term CEO's commitment, and they generate convex pay-offs, which persuade long-term and risk-taking behavior.

In addition to stock options, the author suggests others type of incentives as provisions, for example, golden parachutes, which support managers face to minor shareholders exigencies and protect them in case of involuntary turnover. Golden parachutes are considered, also, as greater incentives for executives to invest in long-term projects with higher risk level.

Furthermore, Dodonova and Khoroshilov (2006) study the nature of the absolute/relative optimal motivation compensation for both loss-averse and myopic executive's attitude. The authors show that the use of stock options grants offer the best incentive for loss-averse executive in the short term. However in the long-term this type of incentive engenders an inefficient equilibrium as it risk over compensating managers. Also authors argue that in various industries, managers with low pay-to-performance compensations desire more options to profit from the long-term upside. In contrast, those with high pay-to-performance compensations don't accept to substitute their base salary with restricted stocks, because accepting this will expose them to larger losses.

According to the theory of persuasion (Girandola et al., 2008), motivation may changes person' attitudes by rising level of stimulation and, so, the behavioral intention (Locke and Latham, 1990 "the goal-setting theory"). So, the CEO's attitude toward decision horizons is conditioned by the importance of motivation produced by the CEO's incentives. Managers' attitudes become less (more) "myopic", in the sense that they tend to overestimates (underestimates) the weight of cash flows occurring after their employment time horizon, when the CEO's incentives is based on performance (fixed).

Referring to the theory of commitment (Joule et al., 2007; Girandola, 2005), motivating person and aligning his attitude cannot effectively produces desired behaviors especially in situations where the tasks don't require high involvement from the part of subjects. Whereas, Deschamps and Joule (2005) suggests that the individual attitude is perceived, only, as a motivation of his behavior. So, they demonstrate that attitude should be supported by the main determinants of the action: "the preparatory act" which refers to the commitment of the subject in the task.

While the absence of correlation between attitudes and behaviors and the polemic role of the motivation (CEO's incentives) and the commitment bias on the attitude change (myopia) and the behavior choice alignment (R&D investment decision), our hypotheses is as follow:

**H2:** *The presence of based-on performance remuneration reduces generally the CEO's myopia attitude.*

**H2':** *With the presence of commitment bias the influence of based-on performance remuneration on CEO's myopia lead to an effective behavior in favor of R&D investment.*

**c) CEO's Incentives, CEO's Loss Aversion, Commitment Bias And Innovation Decision:**

Agency theory presumes that beliefs towards risk diverge between shareholders and managers. In a traditional principal-agent model the principal contracts



with an agent to exercise hard effort to involve an uncertain result. Therefore, remuneration components should be used to link executive and shareholders' tolerance to risk.

Stock options and further performance-linked CEO's incentives are used to align shareholders' long-term risk attitude to manager risk-taking behavior. Holmstrom (1989) demonstrates that trade-off between compensations and risk is fundamental to innovation. Consequently, these necessitate to be considered when challenging to align the two parties' risk behavior. Nevertheless, stock options recompense good performance, but normally do not discipline failure; they serve as a valuable instrument for talent preservation. Similar to Holmstrom's evidence (1989), Manso (2007) finds that traditional principal-agent contracts do not generally give incentives for manager to perform in innovation.

Moreover, March (1991) shows that companies perform two sorts of actions: one is exploration, which requires risk-taking, specific skills and innovational behavior. The second is exploitation, which requires refinement, operational knowledge, efficiency and accomplishment. These actions compete, together, for resources' allocation. The traditional principal-agent contracts persuade agents to decide activities with lower riskiness. Consequently, the agent would shift effort and resources from innovative projects to actions that entail exploitation of current skills.

Holmstrom (1989) verifies that, as the riskiness of the project augments, the executive's share in the result simultaneously declines. In fact, this engenders weaker effort which necessitates, then, superior monitoring costs. As innovation decision is risky, durable, specific and idiosyncratic; manager, generally, avoid innovative projects for less risky ones.

Reed (2007) affirms that compensation with stock-option grants persuade manager to adopt a risky behavior, because there is no penalization mechanism of failure. The author's model shows that a superior amount of stock options arise the probability of CEO's risk-taking and on the total negative investments. Consequently, the author proposes alternative compensation incentives such as: oblige executive to acquire a certain number of stocks, which will link more directly their remuneration to shareholders' wealth. At the same, Walter (2009) suggests a bonus/malus compensation structure where bonuses might be ignored when goals are not fulfilled. Author suppose that when good performances are added to the bonus pool in the same way that bad performances deduct to it, this participate greatly to align the CEO's risk-taking behavior with those of shareholders.

Surprisingly, Sawers et al. (2006); by comparing the role of stock options/restricted stock on manager behavior; find that managers compensated with stock

options are less risk-taking than managers remunerated with restricted stock.

The authors affirm that in general, managers are less risk-averse in the loss context than the gain context. These results propose that as executive have larger wealth at risk, they become more risk-averse. Basing on the behavioral agency model, authors consider that the relation between the decision context and the stock-based compensation describe well the CEO's risk behavior.

Some researches in the psychology literature offer a number of insights into the role of compensation on the CEO's stimulus to innovate. Amabile (1996) argues that for projects that need originality, setting up too much incentive systems can reduce performance because they could closely focus the executive on a certain goal and affect negatively his risk-taking behavior. McGraw (1978) and McCullers (1978) show, also, that pay for performance persuades operational activities in a firm.

This negative impact of performance-based incentive on CEO's risk-taking behavior results from the hidden costs of incentives such the corruption effect and cognitive evaluation theory (Deci, 1975). The majority of these views discuss the "crowding out effect" which argues that there is a regular relationship between intrinsic and extrinsic motivation. The pay for performance (extrinsic motivation contracts) weakens the intrinsic motivation to work.

In term of the theory of persuasion (Girandola et al., 2008; Chappé et al, 2007), motivation play a great role on changing subject's attitude by inserting the sight of the "efficacy" of the risky behavior. In the prospect theory, Kahneman and Tversky, (1979); Tversky and Kahneman, (1992) present the notion of "framing" which consists to present simultaneously information concerning risk and others motivation consequences (the presence of gain or absence of loss). The "framing" affects the individual risk's attitude. Referring to Rothman and Salovey, (1997), motivation activates relationship between expected behavior and the attitude toward the task.

As a result, managerial attitude toward risky behavior is conditioned by the importance of the incentives. Managers' attitudes become risk-taking (loss-averse) in the sense that they choose (avoid) innovation decision, when the CEO's incentives is based on performance (fixed).

Although, relate to the argument of the theory of commitment, (Joule et al., 2007; Girandola, 2005, Girandola et al, 2008), the individual final behavior don't normally be conform to its attitude toward behavior. It is conform only when person attain a high level of commitment bias (Deschamps and Joule, 2005). Based on this affirmation, we hypothesize that if the relationship between manager and risk investment decision is qualified by a high level of cognitive and psychological

commitment, the role of remuneration based-on performance on the CEO's loss aversion attitude, affect consequently his behavior. In the other hand, with the absence of commitment link between manager and risk investment decision, the motivation have not influence on CEO's risk investment behavior.

So, our hypothesis is as follow:

**H3:** *The presence of based-on performance remuneration reduces generally the CEO's loss aversion attitude.*

**H3':** *With the presence of commitment bias the influence of based-on performance remuneration on CEO's loss aversion lead to an effective behavior in favor of R&D investment.*

#### d) CEO's Incentives, CEO's Executive Power And Innovation Decision

Of the three levels of managerial latitude determinants, the manager's executive power has received the great attention as a person feature, (Hambrick and Abrahamson, 1995; Mitchell et al., 2009). Authors propose that if manager has a strong belief that decisions and choices are under his control, he has an internal locus of control. Therefore, basing on his executive power perception he tends to reveal more authority while making decisions and consequently has more discretionary space.

Executive power is often associated to organizational tenure (Chen et al, 2011). It is habitually demonstrated that the longer a manager has been employed at a firm, the more power he has in his decision making process, and thus, the more discretion he manage.

The CEO's executive power lead him believe to have an excellent ability to predict the potential state of nature. As a result, Haleblan and Finkelstein (1993) show that powerful managers may damage the organizational learning because they may "restrict the flow of information", and so, they take in hand all decision making rights and consequences.

Finkelstein and Hambrick (1989) discover that CEO's tenure is related to CEO's incentives system because executive power "accrues for a while and then diminishes, due to the CEO's reduced mobility" in the market.

Similarly, by studying the relationship between incentives and CEO's performance in innovation decision, Francisa et al., (2012) approach as to whether particular form of the CEO's pay package can persuade their innovation behavior.

Linking manager's wealth to the stock price affects executive's power towards risk (Jensen and Meckling 1976; Haugen and Senbet 1981). Stock options incentivize managers to support more risk, it is looked as a mechanism encouraging positive attitude in favor to innovation. Subsequently to the literature on stock options (Agarwal and Mandelkar 1987; Coles, et

al., 2006), Francisa et al., (2012) investigate the relationship between CEO's wealth sensitivity in options to a unit adjust in volatility (vega) and innovation, they find that the vega has a positive liaison with innovation. As the same of the theory of persuasion (Girandola et al., 2008), motivation may affect person's attitudes by rising level of stimulation and, so, increasing his executive's power. Consequently, the CEO's attitude toward decision executive's power is conditioned by the importance of motivation produced by the CEO's incentives.

Although, according to the theory of commitment (Joule et al., 2007; Girandola, 2005), stimulating a person's positive attitude and a high executive's power perception cannot effectively produces authentic behaviors especially when the action has not a high involvement from the part of decider. Whereas, Deschamps and Joule (2005) demonstrate that attitude should be supported by "the preparatory act" which refers to the commitment link between individual attitude and action.

So, our hypothesis is as follow:

**H4:** *The presence of based-on performance remuneration arises generally the CEO's executive power perception.*

**H4':** *With the presence of commitment bias the influence of based-on performance remuneration on CEO's executive power perception lead to an effective behavior in favor of R&D investment.*

#### e) CEO's Incentives, CEO's Overconfidence and Innovation Decision

As Li and Tang (2010) consider that when the "individual's certainty about his or her own predictions exceeds the accuracy of those predictions" he is an overconfident person. When there is a positive and considerable deviation between one's predictions and the real state of position, their actions become overconfident.

Generally, overconfident executives' decisions lead to commit such errors because they overestimate their ability of success higher than that of failure (Audia et al., 2000). Ben-David et al. (2007) demonstrate that companies with overconfident managers tend to overinvest using more debt and lower discount rates; also, they frequently invest in the long-term more than short-term.

Hackbarth (2008) shows that overconfident executive has, generally, a risk-taking attitude. Such attitude participates, mainly, in reducing agency cost, and, converging executives and shareholders interests. Moreover, over-confidence is often sign of person's ability (Gilovich et al., 2002), as a result, over-confident managers are more likely to promote in corporate specific investment.

Such advanced by Gervais et al., (2003), overconfidence and optimism can arise the

performance of the firm. Therefore, in the case of innovation decision, the overconfident manager, compared to rational manager, perform better in the profit of shareholders interests. In the purpose of promoting innovation, authors consider that encouraging rational manager to behave as overconfident manager and, so, protecting the shareholders' interest, can be made by employing convex remuneration system.

However, Shefrin (2001) notes that CEO's incentive mechanism promotes the firm's value maximization by encouraging the CEO's overconfidence attitude; but, the motivation (persuasion) alone cannot surmount the effect of behavioral obstacles (Joule et al., 2007; Girandola, 2005). Therefore, with referring to commitment theory (Deschamps and Joule, 2005), CEO's incentives can produces both behavioral and altitudinal change if there is a commitment link between manager and the innovation decision.

So, our hypothesis is as follow:

**H5:** *The presence of based-on performance remuneration arises generally the CEO's overconfidence.*

**H4':** *With the presence of commitment bias the influence of based-on performance remuneration on CEO's overconfidence lead to an effective behavior in favor of R&D investment.*

### III. METHODOLOGY

#### a) Data Sample Selection

Our empirical study is based on quantitative research. We use a questionnaire as a method of data collection. Our questionnaire consists of four main parts, based on treated areas in theory:

The first part aims to collect some company's information from firm's statute and financial annual statement: CEO's CEO's incentives, total assets, R&D expense, ...

The second part focuses on determination of the level of CEO's commitment bias.

The third part focuses on determination of the CEO's emotional bias.

Part four aims to knowing the level of CEO's executive power.

The questionnaire is addressed to managers in 220 non-financial Tunisian companies during the revolution period (2010-2011 fiscal year), 29 are listed companies and 191 are non-listed companies chosen from the list of firms implanted in the region of Tunis and Sfax provided by "Agency of promotion of industry" in these region (table 1). All financial firms were eliminated to the fact that this sector is regulated and have particular governance system and characteristics. Firms with insufficient data regarding about CEO's emotional bias are also excluded.

Table 1 : Visited Companies

	Total	Number
Initial BVMT sample		50
Financial firms		(22)
	28	
Other non financial firms		270
	298	
Insufficient data to emotional biases		78
Final sample	220	

The selected sample correspond to firm managers or CEO's representing ranging in age from 30 to 70 (table 2). In some firms questionnaires have been distributed by the method of door to door to been delivered to the concerned person, few among them have been mailed and most of them have been contacted via two accounting firm with which we have a great relationship.

Table 2 : Profile of subjects

	Total	Percentage
<b>Firm's Activity</b>		
Agriculture and crafts	16	7
Industry	128	58
Commerce and Service	76	35
<b>CEO's tenure</b>		
<5 years	33	15
5-10 years	125	57
> 10 years	62	28
<b>CEO's Age</b>		
<46	146	66
≥46	74	34
<b>Total</b>	220	100

#### b) Variables' Measurement

On this context we aim to determine the endogens and exogenesis variables' measurement.

##### i. Managerial latitude: innovation decision

We use the research and development (R&D) intensity as a proxy for firm specific assets. As Francis and Smith (1995), Cho (1988), Abdullah et al. (2002) and Hamza and Jarboui (2012), we evaluate innovation decision by the ratio of a firm's R&D expense divided by total assets.

The R&D intensity takes 2 follows:

- 1 if this ratio > 50%;
- 0 if not.

##### ii. CEO's incentives

The remuneration incentives are usually measured using delta and/or vega. Delta is the

sensitivity of CEO portfolio wealth to a 1% change in stock price. However, vega is the sensitivity of CEO portfolio wealth to a 0.01 change in the standard deviation of stock return. Numerous studies are using these measures, we cite for example, Knopf et al. (2002), Rajgopal and Shevlin (2002), Coles et al. (2006) and Core and Guay (2002).

Although, to proceed easily we decide to calculate this variable as dichotomous; it takes 1 when the manager's CEO's incentives is based on firm's performance; and, 0 when it is fixed.

### iii. *CEO's Commitment bias*

To measure the CEO's commitment bias, we takes the same steps than the most of studies have using an adaptation of the original questionnaire elaborated by Meyer and Allen (1991) to evaluate organizational commitment (Organizational Commitment Scale). This instrument is chosen because of its validity and its multidimensional character shown by several researches (Meyer and *al.*, 2002) and Hamza and Jarboui (2012). The commitment bias takes 2 follows:

2 if the manager has a high level of this bias  
1 if not

### iv. *CEO's emotional bias*

To determinate the CEO's three emotional biases (optimism, loss aversion, myopia and overconfidence). The questions have been inspired from the questionnaires formulated by the Fern Hill and Industrial Alliance companies.

The emotional bias takes 2 follows:

2 if the manager has a high level of this bias  
1 if not

### v. *CEO's executive power*

To determinate the CEO's executive power we elaborate questionnaire with---- items in the Based on this ratio, the CEO's expertise power is as follows:

1 if it is high;  
0 if it is low.

### c) *Methods*

The objective of this part is to test the diverse correlations between the innovation investment decision and the above variables. The employed methodology is a probabilistic graphical model called Bayesian network. This methodology is inserted on the artificial intelligence explanatory method. Bayesian network is used in this paper to explain quantitatively the effect of commitment bias on the CEO's behavior in innovation investment decision.

The basic definition of a Bayesian network is given by (Pearl, 1986) who is declared that a Bayesian network is an explicit probability graph, which joins the estimated variables with arcs. This type of association articulates the conditional relationship between the variables. The formal description of Bayesian network is expressed as the set of {D, S, P}, where.

➤ D is a designation of variables or "nodes": in our case it refers to Firm's investment decision escalation, CEO's commitment level, CEO's risk profile, CEO's cognitive dissonance, Firm board of director's independency, Firm ownership concentration, CEO's CEO's incentives, Firm financial strength indicators, Firm's leverage rate, and, Firm's R&D intensity.

➤ S is a designation of "conditional probability distributions" (CPD).  $S = \{p(D / \text{Parents}(D) / D \in D)\}$ ,  $\text{Parents}(D) \subset D$  means that for all the parent nodes for D,  $p(D/\text{Parents}(D))$  is the conditional distribution of variable D. Firm's investment decision escalation.

➤ P is design the "marginal probability distributions".  $P = \{p(D) / D \in D\}$  refers to the probability distribution of variable D.

In the Bayesian network method, the problematic may be modeled with the actions of all variables. In general, three levels in modeling process are applied: initially we approximate the probability distribution of each variable and the conditional probability distribution between them. Secondly, basing on these estimations we can acquire the combined distributions of these variables. Finally, we can exercise some deductions for some variables in the objective to use some other important variables.

### d) *Result Analysis*

#### i. *Model Construction and Parameterization*

The idea of this paper is to precise the importance of CEO's commitment bias as a first-order feature of firm's innovation decision. Also we aim to prove that, the presence of a solid incentive system (persuasive communication), has a great effect on manager's innovation attitude but not on manager's innovation behavior. The relationship between CEO's incentive, CEO's innovation attitude (optimism, myopia, loss aversion, expertise power and overconfidence) and CEO's innovation behavior may be activated only with the existence of commitment bias. Thus, it has been shown theoretically that the firm innovation decision depends on:

- CEO's CEO's incentives
- CEO's commitment bias
- CEO's optimism
- CEO's myopia
- CEO's loss aversion
- CEO's executive power
- CEO's overconfidence

#### ii. *Definition of Network Variables and Values*

The initial step in constructing a Bayesian network model is to list all variables respectively, classified from the target variable to the causes. The variables definition is presented in the table below:



Table 3 : The network variables' definition and mesures

Variables	Type
<b>Innovation decision</b>	Discret : YES/NO
<b>CEO's incentives</b>	Discret : fixed/based on performance
<b>Commitment bias</b>	Discret : YES/NO
<b>CEO's optimism</b>	Discret: YES/NO
<b>CEO's myopia</b>	Discret: YES/NO
<b>CEO's loss aversion</b>	Discret : YES/NO
<b>CEO's executive power</b>	Discret : WEAK/MODERATE/STRONG

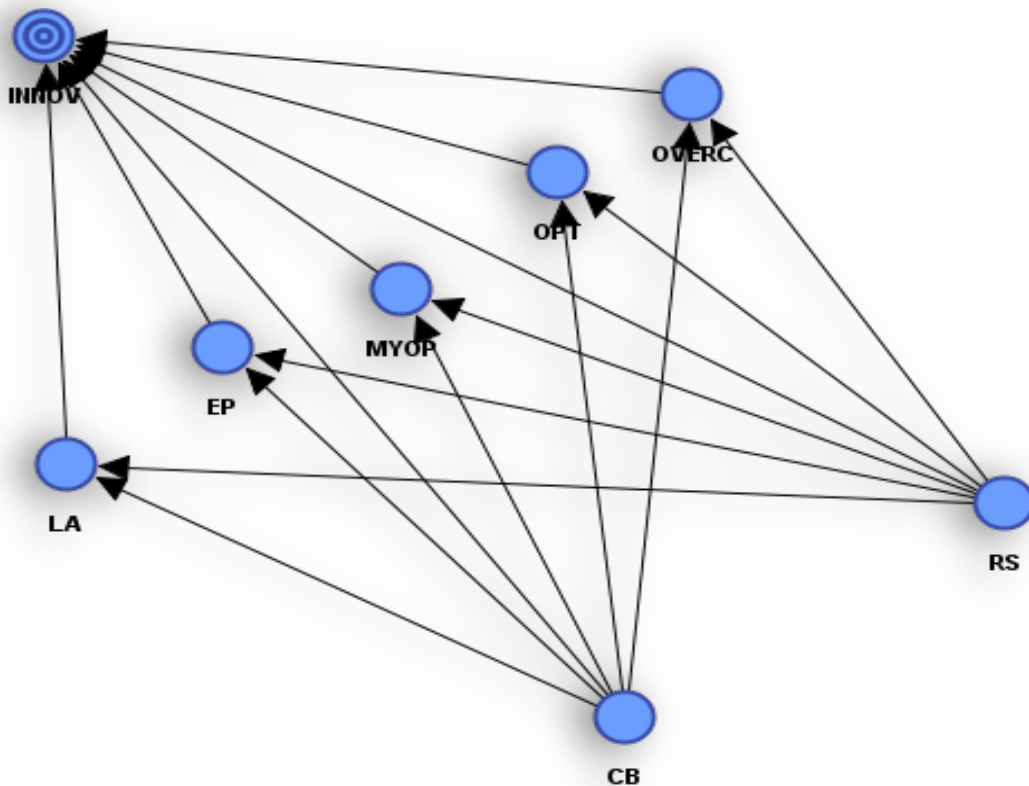
#### IV. RESULTS ANALYSIS AND DISCUSSION

##### a) Graphical Model

The second step in constructing a Bayesian network model is to test the relationships between variables. The Bayesian network constructed using the

BayesiaLab program is the result of the total variables database. The graphical relationship established between variables attaching to the data that we have obtained through the questionnaire, is shown in this figure.

Figure 1 : Graphical model presentation



##### b) Analysis of the Discovered Relationships

The relationships between the variables in the parent node and child node are measured using three indicators: the Kullback-Leibler, the relative weight and the Pearson correlation. The Kullback-Leibler and the relative weight are two indicators that show the

concreteness of relationships and the importance of correlation between variables. Whereas the Pearson correlation, which progresses from 0 to 1; indicates the significance of variables relationship. Thus, the table 4 shows the relationships analysis between variables across the Bayesian network.

Table 4 : The relationships analysis

PARENTS NODES	CHILDS NODES	KULLBACK-LEIBLER DIVERGENCE <sup>(a)</sup>	RELATIVE WEIGHT <sup>(b)</sup>	PEARSON CORRELATION <sup>(c)</sup>
EP	INNOV	0,3069	1,0000	0,0956*
RS	INNOV	0,2594	0,8454	0,0634**
CB	INNOV	0,2538	0,8270	0,0461**
LA	INNOV	0,2523	0,8223	0,0684**
MYOP	INNOV	0,2457	0,8008	0,1159
OPT	INNOV	0,2440	0,7950	0,0729*
OVERC	INNOV	0,1862	0,6069	-0,0049***
CB	EP	0,0160	0,0523	0,0590**
RS	EP	0,0135	0,0438	-0,0191***
RS	OPT	0,0059	0,0192	-0,0700**
CB	OPT	0,0055	0,0181	-0,0665**
RS	LA	0,0044	0,0143	0,0244**
CB	LA	0,0040	0,0130	-0,0034***
RS	MYOP	0,0028	0,0092	0,0624**
CB	MYOP	0,0018	0,0057	0,0491**
RS	OVERC	0,0027	0,0087	-0,0606**
CB	OVERC	0,0008	0,0027	0,0333**

**Notes:****(a) Kullback-Leibler close to 1: important correlation between the variables****(b) Relative weight close to 1: important correlation between the variables.****(c) Pearson correlation:\*, \*\*, \*\*\*, respectively at 10%, 5%, and 1%.**

Concerning the influence of CEO's incentives on the innovation decision, analysis advanced in table 4 shows the presence of direct, strong (Kullback-Leibler = 0,2594 / relative weight= 0,8454), positive and significant ( $\beta = 0,0634^{**}$ ) relationship.

Furthermore there is an indirect influence of CEO's incentives on the innovation decision via the managerial discretion determinants. CEO's incentives has a weak (Kullback-Leibler = 0,0135/ relative weight= 0,0438), negative and significant ( $\beta = -0,0191^{***}$ ) effect on CEO's expertise power. It has a weak (Kullback-Leibler = 0,0059/ relative weight= 0,0192), negative and significant ( $\beta = -0,0700^{**}$ ) effect of CEO's optimism. Also, CEO's incentives has a weak (Kullback-Leibler = 0,0044/ relative weight= 0,0143), positive and significant ( $\beta = 0,0244^{**}$ ) effect on CEO's loss aversion. It has a weak (Kullback-Leibler = 0,0028/ relative weight= 0,0092), positive and significant ( $\beta = 0,0624^{**}$ ) effect of CEO's myopia. Finally, CEO's incentives has a weak (Kullback-Leibler = 0,0027/ relative weight= 0,0087), negative and significant ( $\beta = -0,0606^{**}$ ) effect on CEO's overconfidence.

Concerning the influence of CEO's attitude on the innovation decision, analysis advanced in table 4 shows the presence of strong (Kullback-Leibler = 0,3069/ relative weight= 1,0000), positive and significant ( $\beta = 0,0956^{*}$ ) effect of CEO's expertise power. It shows

also, a strong (Kullback-Leibler = 0,2523/ relative weight= 0,8223), positive and significant ( $\beta = 0,0684^{**}$ ) effect of CEO's loss aversion. Moreover, there is a strong (Kullback-Leibler = 0,2457/ relative weight= 0,8008), positive and insignificant ( $\beta = 0,1159$ ) effect of CEO's myopia. Analysis shows also, the presence of strong (Kullback-Leibler = 0,2440/ relative weight= 0,7950), positive and significant ( $\beta = 0,0729^{*}$ ) effect of CEO's optimism. Finally, CEO's overconfidence has a moderate (Kullback-Leibler = 0,1862/ relative weight= 0,6069), negative and significant ( $\beta = -0,0049^{***}$ ) effect on innovation decision.

Concerning the influence of CEO's commitment bias on the innovation decision, analysis advanced in table 6 shows the presence of direct, strong (Kullback-Leibler = 0,2538/ relative weight= 0,8270), positive and significant ( $\beta = 0,0461^{**}$ ) relationship.

Additionally there is an indirect influence of CEO's commitment bias on the innovation decision via the managerial discretion determinants. CEO's incentives has a weak (Kullback-Leibler = 0,0160/ relative weight= 0,0523), positive and significant ( $\beta = 0,0590^{**}$ ) effect on CEO's expertise power. It has a weak (Kullback-Leibler = 0,0055/ relative weight= 0,0181), negative and significant ( $\beta = -0,0665^{**}$ ) effect of CEO's optimism. Also, CEO's incentives has a weak (Kullback-Leibler = 0,0040/ relative weight= 0,0130),

negative and significant ( $\beta = -0,0034^{***}$ ) effect on CEO's loss aversion. It has a weak (Kullback-Leibler = 0,0018/relative weight= 0,0057), positive and significant ( $\beta = 0,0491^{**}$ ) effect of CEO's myopia. Finally, CEO's incentives has a weak (Kullback-Leibler = 0,0008/relative weight= 0,0027), positive and significant ( $\beta = 0,0333^{**}$ ) effect on CEO's overconfidence.

c) *Analysis of the Firm's Innovation Decision (RDI)*

To analyze the firm's innovation decision, we express, firstly, the innovation decision variable as

a target in the Bayesian network. Secondly, we use the function that produces the analysis report of the target firm's innovation decision. According to this report, the correlation between firm's innovation decision and other variables are approximated by binary mutual information and the binary relative importance.

Table 5 : Target variable analysis

INNOV = YES (57, 6908%)					
Nodes	Binary mutual information <sup>(a)</sup>	Binary relative importance <sup>(b)</sup>		Modal value(c)	
MYOP	0,0097	1,0000	NO	59,9134%	
EP	0,0080	0,8263	AVERAGE	69,1260%	
OPT	0,0038	0,3950	YES	57,9622%	
LA	0,0034	0,3474	YES	61,5656%	
RS	0,0029	0,2984	PERFBASED	56,3419%	
CB	0,0015	0,1584	YES	53,7926%	
OVERC	0,0000	0,0018	NO	73,8025%	
INNOV = NO (42, 3092%)					
Nodes	Binary mutual information <sup>(a)</sup>	Binary relative importance <sup>(b)</sup>		Modal value(c)	
MYOP	0,0097	1,0000	YES	51,7628%	
EP	0,0080	0,8263	AVERAGE	58,9186%	
OPT	0,0038	0,3950	YES	50,6196%	
LA	0,0034	0,3474	YES	54,7489%	
RS	0,0029	0,2984	FIXED	50,0527%	
CB	0,0015	0,1584	NO	50,8741%	
OVERC	0,0000	0,0018	NO	73,3682%	
(a) Mutual information: is the amount of information given by a variable on the target value. It is calculated in bits.					
(b) Relative importance: presents the importance of a variable with respect to the target value.					
(c) Modal value: is the average value of the explanatory variable for each target value.					

The target variable analysis « investment decision escalation » show that 57,6908% of Tunisian companies decide innovation in the post revolution period (2010-2011).

Moreover, results show, for each value of the target, the list of nodes that have a probabilistic dependence with the target, sorted by descending order according to their relative contribution to the knowing of the target value.

In the case of innovation the most important nodes in term of informational relative contribution is, consecutively, the CEO's long-term attitude (myopia=no) (Binary relative importance=1.000), the importance=0,8263), the CEO's optimism (Binary relative importance=0,3950), the CEO's loss aversion (Binary relative importance=0,3474), the based on performance remuneration system (Binary relative importance=0,2984), the CEO's commitment bias

(Binary relative importance=0,1584) and, finally, the absence of CEO's overconfidence (Binary relative importance=0,0018).

While, in the case of no innovation the most important nodes in term of informational relative contribution is, consecutively, the CEO's short term attitude (myopia=yes) (Binary relative importance=1.000), the CEO's moderate expertise power (Binary relative importance=0,8263), the CEO's optimism (Binary relative importance=0,3950), the CEO's loss aversion (Binary relative importance=0,3474), the fixed remuneration system (Binary relative importance=0,2984), the absence of CEO's commitment bias (Binary relative importance=0,1584) and, finally, the absence of CEO's overconfidence (Binary relative importance=0,0018). Additionally, the profile for each value of the target is described by the modal value of each influencing

nodes. These profiles are compared with the a priori modal values of the nodes i.e. when the target variable is unobserved.

In the case of innovation the most important modal value is given by the node of the CEO's long term attitude (myopia= no) (modal value =59,9134%), the CEO's moderate expertise power has a great influence on the target profile (modal value =69,1260%), the CEO's optimism has a considerable effect on the target profile (modal value =57,9622%), the CEO's loss aversion determinate the target profile (modal value =61,5656%), the based on performance's remuneration system describe well the target profile (modal value =56,3419%), also, the CEO's commitment bias describe mainly the target profile (modal value =53,7926%), finally, the absence of CEO's overconfidence explain greatly the target profile (modal value =73,8025%).

While, in the case of no innovation the most important modal value is given by the node CEO's short term attitude (myopia= yes) (modal value =51,7628%),

the CEO's moderate expertise power has a great influence on the target profile (modal value =58,9186%), the CEO's optimism has a considerable effect on the target profile (modal value =50,6196%), the CEO's loss aversion determinate the target profile (modal value =54,7489%), the fixed remuneration system describe well the target profile (modal value =50,0527%), also, the absence of CEO's commitment bias describe mainly the target profile (modal value =50,8741%), finally, the CEO's underconfidence explain greatly the target profile (modal value =73,3682%)

#### d) Maximization of the Target Average (RDI)

The target dynamic profile capability software is a test enhanced by BayesiaLab program to provide the percentage of explanatory variable to maximize the target variable value. Table 6 presents the dynamic profile of the **Firm's innovation decision (RDI)**

Table 6 : Target dynamic profile analysis

INNOV = YES			
Noeud	Modalité optimale	Probabilité	Probabilité jointe
<b>A priori</b>		57,6908%	100,0000%
<b>MYOP</b>	NO	62,8751%	54,9733%
<b>EP</b>	AVERAGE	67,8484%	35,6709%
<b>LA</b>	YES	73,2487%	20,9030%
<b>RS</b>	PERFBASED	85,7370%	11,8477%
<b>OPT</b>	NO	95,0628%	5,7373%
<b>OVERC</b>	NO	100,0000%	4,3593%
INNOV = NO			
Noeud	Modalité optimale	Probabilité	Probabilité jointe
<b>A priori</b>		42,3092%	100,0000%
<b>EP</b>	STRONG	50,4692%	1,0248%
<b>MYOP</b>	YES	56,2013%	0,4679%
<b>LA</b>	NO	63,6986%	0,2118%
<b>CB</b>	NO	73,4721%	0,1236%
<b>OPT</b>	YES	86,0465%	0,0805%
<b>OVERC</b>	NO	100,0000%	0,0580%

The target dynamic profile analysis presented in table 6 show two following results:

First, with the 57,6908% augmentation in innovation decision it is associated an augmentation of the effect of CEO's long term attitude, CEO's moderate expertise power, CEO's loss aversion, based on performance remuneration system respectively with (62,8751%, 67,8484%, 73,2487%, 85,7370%). In the other hand this augmentation is associated with the decrease of optimism and overconfidence respectively with (95,0628%, 100,0000%)

Secondly, with the 42,3092% decrease in innovation decision its associated an augmentation of the effect of CEO's strong expertise power, CEO's myopia, CEO's optimism respectively with (50,4692%,

56,2013%, 86,0465%). In the other hand this decrease is associated with the decrease of loss aversion, commitment bias and overconfidence respectively with (63,6986%, 73,4721%, 100,0000%).

## V. CONCLUSION

This research examines the relationship between CEO's incentives as an organizational managerial discretion's determinants and firms' innovation decision. The originality of this work is that we investigate this relationship in the setting of both psychological theory of persuasion and theory of commitment. For that, we mediate the CEO's attitude variables (optimism, myopia, loss aversion, executive power and overconfidence) in the relationship between



CEO's incentives and firms' innovation decision. For this goal we have implemented a survey conducted around some executives of large private companies in Tunisia in the post revolution period.

Actually, the collected data analysis has confirmed the theoretical analysis which indicates that CEO's innovation behavior is the consequences of the impact of motivational and persuasive effort exerted by remuneration mechanism on CEO's attitude, and, principally, the result of an important commitment link existing between manager and innovation tasks.

Furthermore, the empirical analysis of the relationship between governance mechanisms (CEO's incentives), CEO's attitude and CEO's behavior show that associating manager's remuneration to the firm performance influences his attitude and, in case of committed manager, his behavior in corporate R&D and innovation. In our analysis we find that in presence of based on performance incentives, R&D investments have increased over time. While, this role of incentives is authentically only when there is a strong commitment which link executives and innovation decision. In this paper we approach as to whether CEO's pay for performance can persuade a positive manager's attitude toward innovation, however, this attitude cannot lead to an authentic behavior only in the presence of commitment bias.

Indeed, we can say that the main lesson of this study for Tunisian companies is to incorporate the commitment aspect in the persuasive process by introducing the binding communication in order to align both the CEO's and shareholders' interest and managing the executive discretionary space.

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